duce any unpleasant feelings. This should be an adjunct to the other treatment and applied for a few hours night and morning. This will seldom fail to relieve the condition of delayed union, and assist in the cure of non-unions.

Bier has also suggested the injection of twenty to thirty c.c. of blood from the patient between the ends of the fracture. The ends of the bones may be stimulated by applying counter-irritation over the seat of fracture by percussing the parts with a hammer, so as to produce a local congestion. Forcibly rubbing the ends of the bones together has many advocates. Some irritate the ends of the bones by drilling into them. Injecting irritants such as tincture of iodin between the ends of the bones is used with some success.

The most practical method is to expose ends of the bones, resect them so that you have the parts as nearly like a fresh fracture as possible. The bones are retained in position by means of sutures, staples, pins, or better, strong metallic plates such as are recommended by Arbuthnot Lane. There is a tendency for the muscles to contract and produce much tension, which may cause a loosening of the screws or a fracture of the plate. Should this be in the leg, by severing the tendo-Achillis, the parts will be retained much easier. One of the most difficult fractures I have found to hold is in the upper third of the thigh, where the upper fragment has a tendency to be tilted outward and forward as a result of the gluteus maximus. In such a case the lower part of the attachment of the muscle should be severed.

The plates are united to the bones by screws. The wound should be closed with the most extreme care. If there is any branch of surgery that requires more perfect technic than any other, it is in this class of work. The parts should be supported by plaster or some form of splint.

Should there be much loss of bone in the arm or leg, the space may be filled by using the accompanying bone and permitting one end to retain its vascular attachment. If the space should be next the upper end of the tibia, the patella may be utilized to procure union.

In 1901 I performed the first case of non-union by transplanting of bone from the lower animals to man, by retaining its vascular attachment.

The case was one of the osteomyelitis of the lower end of the tibia, where it was necessary to remove about five inches of bone. The fore-leg of a small dog, after being prepared, was amputated just above the tarsus, leaving the radius one inch longer than the ulna. The skin and muscles were separated from the dog's leg for five inches. The radius extending into the cavity of the tibia, the ulna along the side of the tibia, which was retained in position by wiring. The skin was closed to near the lower end of the wound, the dog's bone passing out at the lower angle. The large tendons of each leg were severed and each limb closed in plaster-of-Paris. Then the entire dog, except his head and genital organs and the leg of the man, were enclosed in paster-of-Paris. Five weeks later the cast was removed and the bones sawed and placed in contact with the astragalus. Union was firm after a few months and the bone gradually filled in the same size as the tibis. The case was reported in the transactions of the California State Society in 1902, and American Medicine, July 12, 1902.

DISEASES AND INJURIES TO KNEE JOINT AND TREATMENT OF SAME.*

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First, let me express my approbation of the term used by Robert Jones, of Liverpool, England, for this class of cases, that of derangement of the knee joint. Of all the major articulations of the human anatomy, none is more exposed to disease and injury than the knee joint. The more we know concerning afflictions of the knee joint, the more complex the matter becomes. We formerly designated these conditions under two heads—tubercular and non-tubercular. To the surgeon having wide experience in these cases, even with the help of the X-ray, this designation becomes inadequate. It is not always possible to say whether a knee joint is tubercular or non-tubercular. Many knee joints becoming deranged, because of an external injury and non-tubercular for an indefinite period, after such injury, become tubercular in time. We must frequently reserve our diagnosis as to the exact condition until we have had the case under observation for some length of time. As to the conditions which we may find in a deranged knee joint, they may comprise one of the following list of diseases. Synovitis with effusion; tubercular arthritis involving both the synovial membrane and the articular cartilage, or the cartilagenous structures of the joint with little involvment of the synovial structures. We may have a joint deranged by what may prove to be an arthritis deformans, in which many other articulations will be involved; we may have a loose piece of cartilage, as a result of an injury, which acts as a foreign body and in which there is no serious inflammatory condition present, but which, if neglected, frequently becomes tubercular; we may have a serious derangement of the knee joint, due to injury to the semi lunar cartileges, which, if treated, appropriately, will pursue a non-tubercular course, but which, if neglected, frequently undergoes tubercular infection; we may also have a derangement of the knee joint due to constant slight daily trauma, or to the peculiar occupation of the individual, which latter case is frequently not properly diagnosed, or appreciated, in its true light, because the conditions which cause the same are considered to be of not sufficient consequence to produce disease. We may frequently have a gouty condition, aggravated by occupation or injury, resulting in serious derangement of the knee joint. Experience has taught us that frequently the beginning of a serious derangement is a slightly bruised spot. In this bruised spot capillary stasis occurs. If the tubercular bacillus effect a lodgment in such spot, it is the ideal soil for the production of a colony. The cases of tuberculosis of the knee joint arising without memorable history of a serious injury, or perhaps, any injury at all, arise from the

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lodgment of tubercle bacillus within some part of the joint. How long it may take for such infection to manifest itself after having taken place must ever be left to speculation.

A condition which sometimes occurs, without any possible history of trauma, injury from occupation, or other exciting causes, is synovitis with effusion, due to infection from the micro-coccus lanceolatus, of "Frankel." One such case I wish to quote:

A previously healthy, young woman, married, mother of a large healthy infant, her husband particularly strong and healthy, no suspicion of tubercular disease or gonorrhea in either man or wife, had an effusion into the synovial sac of the right knee joint; no pain or inconvenience, until the synovial sac became greatly distended; no history of injury; the patient had never suffered from rheumatism; had never suffered from any condition referable to any joint in her whole anatomy; had always lead a most reputable life; not addicted to the use of alcoholic beverages or drugs; had never been seriously ill in her life; had never been exposed to any unusual hardship or engaged in any occupation bringing undue strain or irritation upon her knees, or any other articulation in her anatomy. For two weeks she sought no medical advice; then the effusion was withdrawn, plaster of paris dressing was applied, and the patient put to bed. Within forty-eight hours an enormous effusion had taken place in the left knee joint, apparently without provocation. No rise in temperature; no pain, except from pressure after the synoval sac had become greatly distended. Under strictest aseptic precaution, the effusion was withdrawn with an aspirator, and the fluid cultured. On blood serum a pure culture was obtained, of micrococcus lanceolatus. No other organism was demonstrated, nor did the culture become contaminated for many days in the laboratory; no demonstrable morbid process developed in the articular cartileges, in either joint. Both joints recovered with perfect function, and remained well for fifteen months, when the same condition in a much less aggravated degree recurred in the left knee joint. Cultures were made on blood serum, agar and bullion. Due to a defective incubator, no results were obtained, but with the withdrawal of the fluid, application of plaster of paris dressing, the patient recovered within two weeks, and for several months has suffered no inconvenience.

A gouty condition, aggravated by constant irritation, as a peculiar daily occupation, may bring about serious derangement of the knee joint. Many are dubbed gouty, rheumatic, etc. The real diagnosis of such conditions is seriously befogged. An individual, who may be the subject of gout, and who has an occupation which brings particular stress on the knee joint, may suffer serious derangement of that joint, frequently resulting in the destruction or one or both of the semilunar cartilages. In these diseases of the semilunar cartilage, we find an outgrowth of bony prominences at the margin of the articular cartilage, where it merges into the bony part of the epiphysis. One such case I have in mind. A man, about thirty-six years of age, who had been many years addicted to the use of alcoholic beverages, consuming large quantities of beer daily, and whose occupation was that of repairing gas tanks, for illuminating gas, carried underneath railroad passenger coaches. In his work he was obliged to kneel almost constantly, and in making hurried repairs, frequently did so without any pad under his knees, kneeling on the hard gravel or plank surface between the tracks. Both knee joints showed a margin of articular cartilage studded with a row of bony, bead-like prominences. One knee became seriously inflamed and painful. This knee he had bruised in such a manner as to loosen the anterior portion of the internal semilunar cartilage. The joint became so painful that he was obliged to enter a hospital. The indications were such as to make the removal of the internal semilunar cartilage a necessity—this will be referred to later.

Treatment.—The treatment of derangement of the knee joint must depend upon the careful diagnosis of the existing condition. Whether the joint should be opened or treated more conservatively, must depend upon the conditions present. One of the principal conditions which will decide as to the operative treatment of the joint, is locking in any degree of flexion. Any knee joint which becomes locked so as to compel the patient to take some time and particular exertion to fully extend the knee, is a positive indication for opening the joint. It means that some structural part of the joint either of the semilunar cartilages, or bone or calcified fatty tag, commonly known as a joint mouse, is acting as a foreign body in the joint, and is a source of irritation and unending trouble until removed. In the case above referred to where the patient's occupation had been that of a repairer of gas tanks, the internal semilunar cartilage was found to be not only loose, shifting in and out, frequently in such a manner as to cause locking of the joint, but shriveled, and dark brown in color, hard and having lost all semblance to its normal condition. This was removed, the joint placed in plaster of paris, and the man advised to seek another occupation. After several months, he returned to his occupation, not knowing what else to do, and has suffered no further trouble with his knee. Joints of this kind are prone to become tubercular, but where this does not occur, after an extended length of time, gross changes take place in the contour of one or both condyles of the femur. Because of the semi-flexed position in which the patient walks, the cancelus structure of the condyles is re-arranged and the former convexity of the part bearing the articular cartilage may become flattened and altered in shape. In connection with this condition, we may consider the operation known as arthroplasty. This sounds well for the instant and while seeming plausible, it is an unnecessary prolongation of a necessary operation without any compensation. Fascia, or other soft structure, pulled into a joint, can never be made to take the place of any cartilaginous structure. It will atrophy within a few weeks, and the result is no better and many times less satisfactory than the simple removal of the offending structure, and careful closing of the joint.

In opening the knee joint, it is practically never necessary to divide the patella, the quadriceps tendon, or any other important structure, which might interfere with the function of the joint. The straight incision about one-half inch internal to the inner margin of the patella, of sufficient length to expose the condyle of the femur and the synovial sac, above the patella, is all that is necessary. By this incision, no important structures are divided, the joint may be thoroughly explored, any offending

loose body removed, the joint closed and speedy recovery take place.

Catgut should not be used in closing the capsule of the joint. The structures are so thin, and ligamentous in character that absorption does not readily take place, and no matter how carefully and properly the catgut may have been prepared, it easily becomes infected from the skin, many days after the wound has apparently healed without infection. The figure of eight silkworm gut suture may be used, the loop of the suture closing the capsule of the joint, and the two ends of the suture closing the skin and fascia, and removed within a few days, leaving no foreign substance in the tissues. One thing that must be strictly observed in any of the above operations on the joint is the prevention of hemorrhage into the joint during the operation. Blood, even in small quantities, permitted to remain in the joint is one of the most potent causes of infection. All bleeding points should be carefully secured, before opening the capsule of the joint, and great care taken in all necessary manipulations so as to prevent, so far as possible, oozing of blood into the joint cavity, and in case blood oozes into the joint cavity it must be carefully and absolutely removed. If there has been no damage or injury to the articular cartilage of the joint, after being carefully closed, it may be put up in plaster of paris, extending from the ankle to the gluteal fold between the hip and thigh. Plaster of paris dressing of less length is useless. If the articular cartilage has been damaged, or injured, extension must be made with weight and pulley, or some form of extension splint, the joint being slightly flexed to relieve tension on the insertion of the hamstring tendons. Without extension or traction, as some surgeons prefer to call it, in the event of damage or injury to the articular structures, the pain is intolerable and is effectually relieved by extension.

One indication for the opening of a joint which is sometimes given undue prominence, is the detection of grating. Grating due to exposed bone, undergoing carious disease, is a late symptom of a badly disorganized joint, and means irreparable damage. It means that the function of a joint cannot be restored and is the result of serious infection. This sign is of no particular value, as the general condition is apparent. The more powerful flexor tendons within a very short time produce sub-luxation of the head of the tibia. With the Sayre's knee extension appliance, properly adjusted, extension is made on the joint relieving the pain and sub-luxation is reduced, and by the strapping of the joint as done by the late Dr. Sayre, the swelling and induration rapidly disappear, and the joint makes good recovery. A mixed infection producing pus in the joint, due to infection from pyogenic organisms, which results in acute abscess, absolutely prohibiting the application of plaster of paris or any ambulatory apparatus, rapidly destroying the structures of the joint, calls for immediate operative interference, rest in bed, extension with the weight and pulley and drainage. Some special cases may be so acute as to call for amputation above the knee as a life-saving measure. These latter cases are exceedingly rare, and the condition is so acute as to admit of no doubt as to the proper procedure. This alternative is mentioned, as a rare exception. Nearly all cases of tubercular disease of the knee joint involving the cartilages make extension imperative. After all inflammatory symptoms have subsided and there is no pain or pressure over the epiphyseal line of the femur, the semi-lunar cartilages, or the coronary ligament, the extension may be removed, and a convalescent dressing of plaster of paris from the ankle to the gluteal fold may be substituted and the patient permitted to gradually bear weight on the limb. After some weeks, the plaster of paris dressing may be removed, and the patient allowed to walk with crutches, gradually moving the joint and bearing weight upon it without support or dressing.

The limbering up process of a knee joint that has pursued a favorable course, is the most critical part of the treatment. To know when it is safe to remove all dressings, and to begin the restoration of the function of the joint is a very nice distinction in surgery.

I have not mentioned the matter of diet and personal habits in the handling of these cases, because it is presumed that all competent surgeons are familiar with such matters.

I have not mentioned the treatment of these conditions by the X-ray, as has sometimes been applied, actual cautery, blisters, painting with iodin, hot fomentations, etc., etc. Nor have I mentioned the treatment by Bier's passive congestion, and application of the hot air or baking process, which latter leads to inflammatory thickening of the synovial membrane, and most other soft structures about the joint, a condition which favors a chronic course of the original disease, and delays or prohibits recovery. Blisters and hot fomentations, and other empyrical methods are useless and should have been obsolete many years ago. Bier's method has nothing to recommend it, and does not even relieve the pain, is positively without merit, permits the disease itself to produce irreparable damage, through loss of timely, proper mechanical treatment. It causes useless atrophy of the muscular structure and is rapidly becoming obsolete in these cases, and must eventually be forgotten. I do not wish to have you understand that I desire to arraign that most eminent surgeon, Dr. Bier. He has contributed much of great value to surgery, but Dr. Bier's method applied to derangements of the knee joint and especially those of an acute nature is wholly without merit and the sooner we recognize this fact the better for our patients.

To sum up: These cases yield immediately to proper mechanical treatment. Treated empyrically, tinkered at by one indifferent method after another, they rapidly go to the bad. The exact condition must be diagnosed and first of all, appropriate mechanical treatment instituted. By this means both pain and inflammation subside and recovery begins immediately.